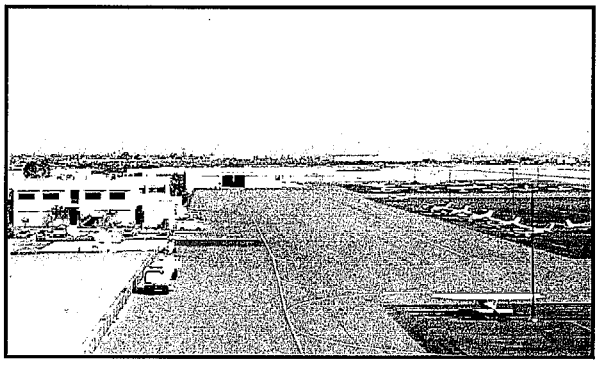
GLENDALE

MUNICIPAL AIRPORT

Chapter Three

AVIATION FACILITY REQUIREMENTS

AVIATION FACILITY REQUIREMENTS



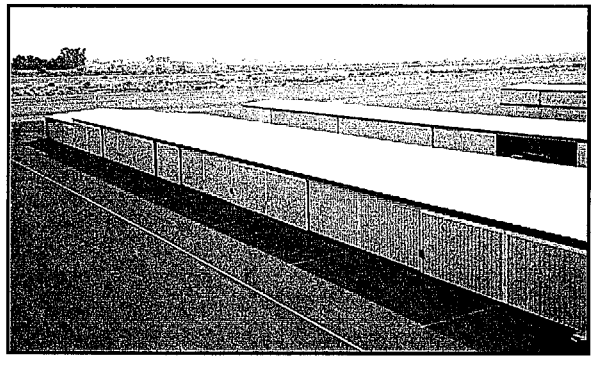
In the previous chapter, forecasts of aviation demand were presented for Glendale Municipal Airport through the year 2020. In this chapter, existing components of the airport and their individual capacities are identified and described. These capacities are compared to forecast demand levels to determine where deficiencies in airport facilities exist or are expected to materialize. Once deficiencies in airport facilities are identified, a more specific determination of the approximate sizing and timing of the new facilities can be made.

The objective of this effort is to identify, in general terms, the adequacy or inadequacy of existing airport facilities, outline what new facilities may be needed, and establish when these may be needed to accommodate forecast demands. After identifying these facility requirements, alternatives for providing these facilities will be evaluated (Chapter Four). The alternatives evaluation will help determine the most functional and efficient means for implementing further development of the facility.

Recognizing that the need to develop facilities is determined by demand, rather than a point in time, the requirements for new facilities have been expressed for the short, intermediate, and long term planning horizons, which roughly correlate to five-year, ten-year, and twenty-year time frames. **Table 3A** summarizes the activity levels that define the planning horizons used in the remainder of this master plan.

AIRFIELD CAPACITY

An airport's airfield capacity is expressed in terms of its annual service volume. Annual service volume is a



reasonable estimate of the maximum level of aircraft operations that can be accommodated in a year. Annual service volume accounts for annual differences in runway use, aircraft mix, and weather conditions. The airport's annual service volume was examined utilizing Federal Aviation Administration (FAA) Advisory Circular (AC) *150/5060-5, Airport Capacity and Delay.*

TABLE 3A
Planning Horizon Activity Levels
Glendale Municipal Airport

	Short Term Planning Horizon	Intermediate Term Planning Horizon	Long Term Planning Horizon
Based Aircraft	235	300	375
Annual Operations	139,000	175,000	215,0000

FACTORS AFFECTING ANNUAL SERVICE VOLUME

Exhibit 3A graphically presents the various factors included in the calculation of an airport's annual service volume. These include: the airfield characteristics, meteorological conditions, aircraft mix, and demand characteristics (aircraft operations). These factors are described below.

Airfield Characteristics

The layout of the runways and taxiways directly affects an airfield's capacity. This not only includes the location and orientation of the runways, but the percent of time that a particular runway or combination of runways is in use and the length, width, weight bearing capacity, and instrument approach capability of each runway at the airport. The length, width, weight bearing capacity, and instrument approaches available to a runway determine which type of aircraft may operate on the runway and if operations can occur during poor weather conditions.

- **Runway Configuration**

The existing runway configuration consists of a single north-south oriented runway: Runway 1-19. A full-length parallel taxiway is available along the west side of the runway. This runway can accommodate all small general aviation aircraft and many business jet aircraft.

- **Runway Use**

Runway use is normally dictated by wind conditions. The direction of take-offs and landings is generally determined by the speed and direction of wind. It is generally safest for aircraft to takeoff and land into the wind, avoiding a crosswind (wind that is blowing perpendicular to the travel of the aircraft) or tailwind components during these operations. Prevailing winds are from the south. As

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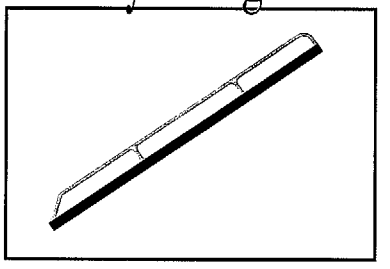
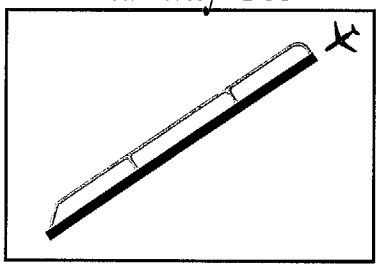
AIRFIELD LAYOUT

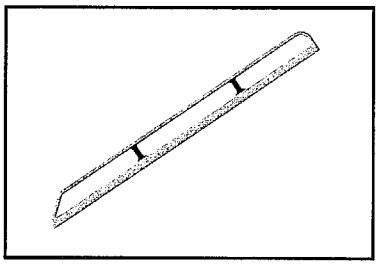
Runway Configuration



Runway Use

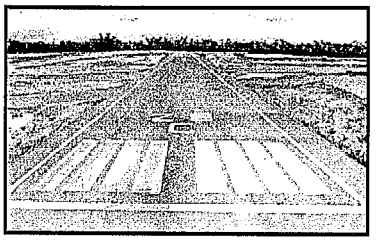


Number of Exits



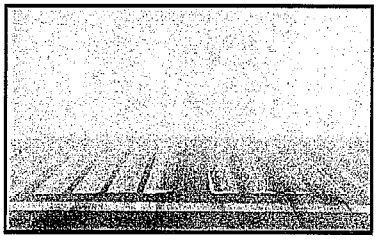
WEATHER CONDITIONS

VFR

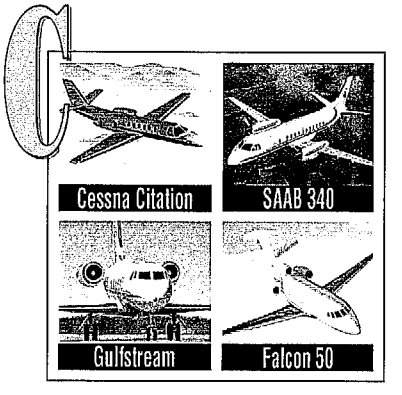


IFR

PVC

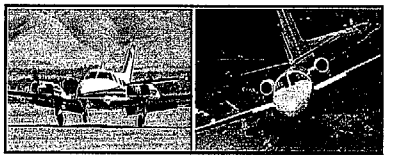


AIRCRAFT MIX

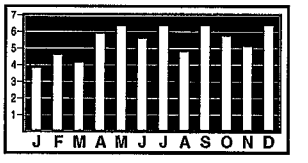


OPERATIONS

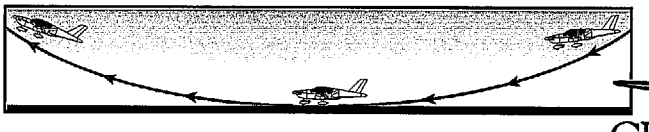
Arrivals and Departures



Total Annual Operations



Touch-and-Go Operations



GLENDALE MUNICIPAL AIRPORT

Exhibit 3A
FACTORS INFLUENCING
ANNUAL SERVICE VOLUME

recommended by the 1994 Part 150 Noise Compatibility Study, Runway 1 is the designated calm wind runway.

- **Exit Taxiways**

Exit taxiways have a significant impact on airfield capacity since the number and location of exits directly determines the occupancy time of an aircraft on the runway. Seven entrance/exit taxiways are available for use along the runway. The airfield capacity analysis gives credit to exits located within a prescribed range from a runway's threshold. This range is based upon the mix index of the aircraft that use the runway. The exits must be at least 750 feet apart to count as separate exits. Under this criteria Runway 1 is credited with two exits and Runway 19 is credited with three exits.

Meteorological Conditions

Weather conditions can have a significant affect on airfield capacity. Airport capacity is usually highest in clear weather, when flight visibility is at its best. Airfield capacity is diminished as weather conditions deteriorate and cloud ceilings and visibility are reduced. As weather conditions deteriorate, the spacing of aircraft must increase to provide allowable margins of safety. The increased distance between aircraft reduces the number of aircraft which can operate at the airport during any given period. This consequently reduces overall airfield capacity.

There are three categories of meteorological conditions each defined by the reported cloud ceiling and flight visibility. Visual Flight Rule (VFR) conditions exist whenever the cloud ceiling is greater than 1,000 feet above ground level, and visibility is greater than three statute miles. VFR flight conditions permit pilots to approach, land, or take off by visual reference and to see and avoid other aircraft.

Instrument Flight Rule (IFR) conditions exist when the reported ceiling is less than 1,000 feet above ground level and/or visibility is less than three statute miles. Under IFR conditions pilots must rely on instruments for navigation and guidance to the runway. Other aircraft cannot be seen and safe separation between aircraft must be assured solely by following air traffic control rules and procedures. As mentioned, this leads to increased distances between aircraft which diminishes airfield capacity.

Poor Visibility Conditions (PVC) exist when the cloud ceiling and/or visibility is less than cloud ceiling and visibility minimums prescribed by the instrument approach procedures for the airport. PVC conditions exist at Glendale Municipal Airport when the visibility and could ceilings deteriorate to a point where visual flight can no longer be conducted.

According to regional data, VFR conditions exist approximately 99 percent of the time, whereas IFR conditions and PVC conditions occur the remaining 1 percent of the time. The FAA capacity model disregards weather conditions that occur less than 2 percent of the time. Therefore, airfield capacity for Glendale Municipal Airport has been determined assuming

that VFR conditions occur 100 percent of the time.

Aircraft Mix

Aircraft mix refers to the speed, size, and flight characteristics of aircraft operating at the airport. As the mix of aircraft operating at an airport increases to include larger aircraft, airfield capacity begins to diminish. This is due to larger separation distances that must be maintained between aircraft of different speeds and sizes.

Aircraft mix for the capacity analysis is defined in terms of four aircraft classes. Classes A and B consist of single and multi-engine aircraft weighing less than 12,500 pounds. Aircraft within these classifications are primarily associated with general aviation operations, but does include some business turboprop and business jet aircraft (e.g. the Cessna Citation business jet and Beechcraft King Air). Class C consists of multi-engine aircraft weighting between 12,500 and 300,000 pounds. This is broad classification that includes business jets, turboprops, and large commercial airline aircraft. Most of the business jets in the national fleet are included within this category. Class D includes all aircraft over 300,000 pounds and includes widebodied and jumbo jets. There are no Class D aircraft currently operating or forecast to operate from the airport. **Exhibit 3A** depicts representative aircraft in each aircraft class.

For the capacity analysis, the percentage of Class C aircraft operating at the airport is critical in determining the annual service volume as this class includes the larger and faster aircraft in the operational mix. The existing and projected operational fleet mix for the airport is summarized in **Table 3B**. Consistent with projections prepared in the previous chapter, the operational fleet mix at the airport is expected to slightly increase its percentage of Class C aircraft as business and corporate use of general aviation aircraft increases at the airport.

Demand Characteristics

Operations, not only the total number of annual operations, but the manner in which they are conducted, have an important effect on airfield capacity. Peak operational periods, touch-and-go operations, and the percent of arrivals impact the number of annual operations that can be conducted at the airport.

- **Peak Period Operations**

For the airfield capacity analysis, average daily operations and average peak hour operations during the peak month is calculated. These operational levels were calculated previously in Chapter Two for existing and forecast levels of operations. Typical operational activity is important in the calculation of an airport's annual service level as "peak demand" levels occur sporadically. The peak periods used in the capacity analysis are representative of normal operational activity and can be exceeded at various times through the year.

TABLE 3B
Aircraft Operational Mix
Glendale Municipal Airport

	A & B	C	D
Existing (1996)	98.5%	1.5%	0%
Short Term	97.0%	3.0%	0%
Intermediate Term	96.0%	4.0%	0%
Long Term	93.0%	7.0%	0%

- **Tough-and-Go Operations**

A touch-and-go operation involves an aircraft making a landing and an immediate take-off without coming to a full stop or exiting the runway. These operations are normally associated with general aviation training operations and are included in local operations data recorded by the air traffic control tower.

Touch-and-go activity is counted as two operations since there is an arrival and a departure involved. A high percentage of touch-and-go traffic normally results in a higher operational capacity because one landing and one takeoff occurs within a shorter time than individual operations. Touch-and-go operations currently account for approximately 70 percent of annual operations.

- **Percent Arrivals**

The percentage of arrivals as they relate to the total operations in the design hour is important in determining airfield capacity. Under most circumstances, the lower the percentage of arrivals, the higher the hourly capacity. However, except in unique circumstances, the aircraft arrival-departure split is typically 50-50. At the airport, traffic information indicated no major deviation from this pattern, and arrivals were estimated to account for 50 percent of design period operations.

CALCULATION OF ANNUAL SERVICE VOLUME

The preceding information was used in conjunction with the airfield capacity methodology developed by the FAA to determine airfield capacity for Glendale Municipal Airport.

Hourly Runway Capacity

The first step in determining annual service volume involves the computation of the hourly capacity of each runway in use configuration. The percentage use of each runway, the amount of touch-and-go training activity, and the number and locations of runway exits become important factors in determining the hourly capacity of each runway configuration.

As the mix of aircraft operating at an airport changes to include a greater utilization of Class C aircraft, the hourly capacity of the runway system is reduced. This is because larger aircraft require longer utilization of the

runway for takeoffs and landings, and because the greater approach speeds of the aircraft require increased separation. This contributes to a slight decline in the hourly capacity of the runway system over the planning period.

Annual Service Volume

Once the hourly capacity is known, the annual service volume can be determined. Annual service volume is calculated by the following equation:

Annual Service Volume = C x D x H	
C =	weighted hourly capacity
D =	ratio of annual demand to average daily demand during the peak month
H =	ratio of average daily demand to average peak hour demand during the peak month

Following this formula, the current annual service volume for Glendale Municipal Airport has been estimated at 271,000 operations. The increasing percentage of larger Class C aircraft over the planning period will contribute to a decline in the annual service volume, lowering it to a level of 261,000 operations by the end of the planning period.

Delay

As the number of annual aircraft operations approaches the airfield's capacity, increasing amounts of delay to aircraft operations begin to occur. Delays occur to arriving and departing aircraft in all weather conditions. Arriving aircraft delays result in aircraft holding outside of the airport traffic area. Departing aircraft delays result in aircraft holding at the runway end until released by the air traffic control tower.

Currently, total annual delay at the airport is minimal and is estimated at 295 hours. If no capacity improvements are made, annual delay can be expected to reach 1,600 hours in the long range planning horizon. During peak periods, delays of 10 to 15 times this average can be experienced by individual aircraft.

Conclusion

Table 3C summarizes annual service volume values. **Exhibit 3B** compares annual service volume to existing and forecast operational levels. The 1996 total of 118,387 operations represented 43% of the existing annual service volume. By the end of the planning period total annual operations are expected to represent 82% of annual service volume.

FAA Order 5090.3B, *Field Formulation of the National Plan of Integrated Airport Systems (NPIAS)*, indicates that improvements for airfield capacity purposes should be considered when operations reach 60 percent of the annual service volume. Should operations occur as forecast, the airport

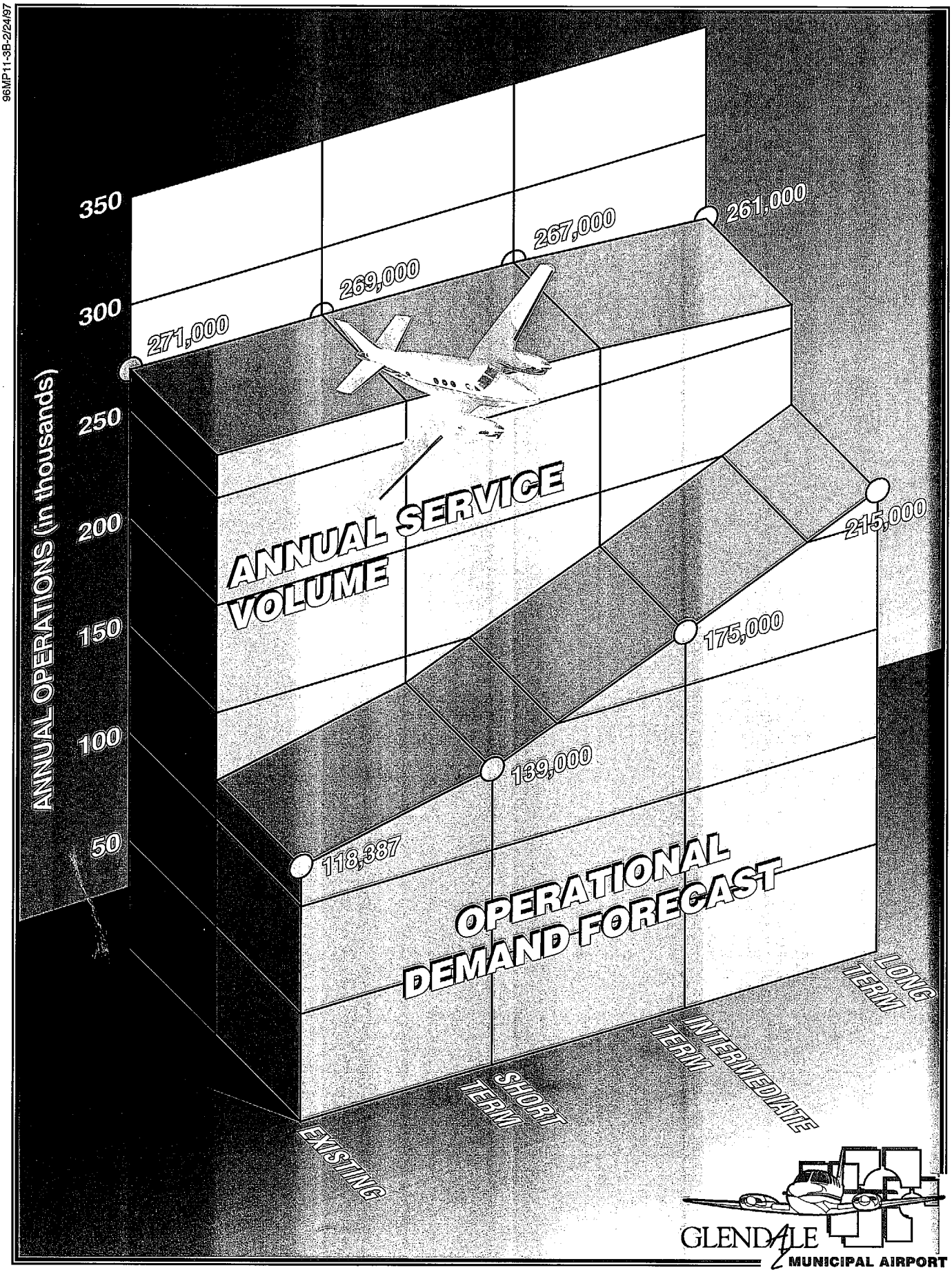


Exhibit 3B
AIRFIELD DEMAND/CAPACITY

is expected to exceed this threshold in the intermediate planning horizon.

Local (touch and go training) operations and increased business aircraft use of the airport will drive the need for additional runway capacity. Previous planning included the development of a parallel runway east of the existing runway to separate training operations and increase capacity. The alternatives analysis will examine the various alternatives available for increasing capacity while maximizing developable property on the east side of the airport.

TABLE 3C
Annual Service Volume Summary
Glendale Municipal Airport

	Annual Operations	Weighted Hourly Capacity	Annual Service Volume	Percent Capacity	Total Annual Hours of Aircraft Delay
Existing (1996)	118,387	128	271,000	43.7%	295
Short Term	139,000	127	269,000	51.7%	463
Intermediate Term	175,000	126	267,000	65.5%	729
Long Term	215,000	123	261,000	82.4%	1,612

AIRFIELD REQUIREMENTS

Airfield requirements include the need for facilities related to the arrival, departure, and ground movement of aircraft. The following facilities are associated with the airfield:

- Runways
- Taxiways
- Airfield Lighting and Markings
- Navigational Aids

RUNWAYS

The Federal Aviation Administration (FAA) has established criteria for use in the sizing and design of airfield facilities. The selection of appropriate FAA design standards for the development of airfield facilities is based upon the characteristics of the aircraft currently using, or projected to use, the airport. Establishing correct design standards is very important, since they are used to plan separation distances between facilities which could be costly to relocate at a later date.

The most important characteristics in airfield planning are the approach speed and wingspan of the critical design aircraft anticipated to use the airport now or in the future. The critical design aircraft is defined as the most demanding category of aircraft which conducts 500 or more operations per year at the airport.

An aircraft's approach category is based upon 1.3 times its stall speed in the landing configuration at the particular aircraft's maximum certified weight. There are five approach categories defined as follows:

Category A: Speed less than 91 knots.

Category B: Speed 91 knots or more, but less than 121 knots.

Category C: Speed 121 knots or more, but less than 141 knots.

Category D: Speed 141 knots or more, but less than 166 knots.

Category E: Speed 166 knots or more.

The second basic design criteria relates to the size of an airplane, in particular, the aircraft's wingspan. There are six airplane design groups defined as follows:

Group I: Wingspans up to but not including 49 feet.

Group II: Wingspans from 49 feet up to but not including 79 feet.

Group III: Wingspans from 79 feet up to but not including 118 feet.

Group IV: Wingspans from 118 feet up to but not including 171 feet.

Group V: Wingspans from 171 feet up to but not including 214 feet.

Group VI: Wingspans from 214 feet up to but not including 262 feet.

FAA AC *150/5300-13, Airport Design*, identifies a coding system which is used to relate airport design criteria to the operational and physical characteristics of aircraft intended to operate at the airport. This code, called the Airport Reference Code (ARC), has two components: the first component, depicted by letter, is the aircraft approach category, defined above; the second component, depicted by a Roman numeral, is the airplane design group.

Generally, aircraft approach speed applies to runways and runway-related facilities, while airplane design group relates to the separation criteria involving taxiways and taxilanes. In order to determine facility requirements, the ARC should first be determined then airport design criteria can be applied.

The FAA recommends designing airport functional elements to meet the requirements of the most demanding, or critical aircraft. As mentioned previously, the critical aircraft is the most demanding category of aircraft with 500 or more annual operations. Glendale Municipal Airport is currently utilized by all types of general aviation aircraft ranging from small single-engine piston aircraft to turboprop and business jet aircraft. Turboprop and business jet aircraft use of the airport is currently limited with small single-engine aircraft comprising the majority of operations at the airport. The potential exists in the future for increased use of the airport by turboprop and business jet aircraft.

The most likely business jets to operate at Glendale Municipal Airport in the future will be business jets weighting up to 30,000 pounds. This commonly includes the Cessna Citation, Dassault Falcon, and Lear Jet series of aircraft. These aircraft comprise the majority of active business jet aircraft and are the most cost-effective for corporations to operate. The Cessna Citations and Dassault Falcon jets fall within ARC B-II while the Lear Jets falls within ARC's C-I and D-I.

ARC B-II design standards have been applied to airfield design at Glendale Municipal Airport in the past. To safely accommodate larger turboprop and business jet aircraft in the future, future facility planning should conform to the more demanding business jet design standards, specifically the range of business jet aircraft less than 30,000 pounds. These aircraft fall within ARC's B-II to D-I. Larger business jets, which may occasionally operate at the airport, such as the Gulfstream series of aircraft, fall within ARC D-II. Since Approach Category C and D design standards are essentially the same, the C-II ARC, which incorporates the more demanding wingspan requirements of business jets such as the Cessna Citation and larger business jets such as the Gulfstream and the approach speeds of the Lear Jet and Gulfstream series of aircraft, has been designated for future facility planning. Should a parallel runway be developed in the future, it would be possible to apply less demanding ARC B-II design standards since this runway will serve mostly smaller, training aircraft.

The adequacy of the existing runway system has been analyzed from a number of perspectives including runway length, runway width, and pavement strength. From this information, requirements for runway improvements have been determined for the airport.

Runway Length

The determination of runway length requirements for an airport are based on five primary factors: airport elevation; mean maximum temperature of the hottest month; runway gradient; critical aircraft type expected to use the airport, and stage length of the longest nonstop trip destinations. Aircraft performance declines as elevation, temperature, and runway gradient factors increase.

Using data specific to Glendale Municipal Airport, runway length requirements for the various classifications of aircraft that may operate at the airport were examined using the FAA Airport Design computer program Version 4.2A which groups general aviation aircraft into several categories, reflecting the percentage of the fleet within each category and useful load of the aircraft. **Table 3D** summarizes FAA recommended runway lengths for Glendale Municipal Airport.

At its present length of 5,350 feet, Runway 1-19 can accommodate the full range of small general aviation aircraft (refer to 100 percent of small airplanes) but falls short of fully accommodating common business jet aircraft (refer to large airplane runway length requirements). In general, the existing runway length is sufficient for departures when temperatures are mild and destinations are to regional markets. To fully accommodate the type of business aircraft likely to operate at the airport safely during summer months and without limiting stage lengths, the FAA recommends a runway length of 7,000 feet.

For comparison, actual runway lengths requirements for common business jets expected to operate at the airport at the mean daily maximum temperature listed above have been analyzed and are included in **Table 3E**. As shown in

the table, runway length requirements vary from a less demanding 4,800 feet for the Cessna Citation I to 7,300 feet for the Gates Learjet 55.

TABLE 3D
Runway Length Requirements
Glendale Municipal Airport

Small airplanes with less than 10 passenger seats	
75 percent of these small airplanes	3,000 feet
95 percent of these small airplanes	3,600 feet
100 percent of these small airplanes	4,300 feet
Small airplanes with 10 or more passenger seats	4,700 feet
Large airplanes between 12,500 and 60,000 pounds	
75 percent of these large aircraft at 60 percent useful load	5,500 feet
100 percent of large aircraft at 60 percent useful load	7,000 feet
Airport Elevation	1065.5 feet
Mean Daily Maximum Temperature of the Hottest Month	104.5° F
Runway Gradient	23.5 feet

Small Aircraft - Aircraft less than 12,500 pounds
Source: FAA Airport Design computer program Version 4.2A.

Glendale Avenue (to the north) and the New River (to the south) restrict an extension of Runway 1-19. The alternatives analysis will examine the feasibility of providing the maximum runway extension while considering these existing restrictions. An ultimate runway length of 7,000 feet will be examined as this length accommodates the runway length requirements of most common business jet aircraft.

Since a potential parallel runway would be built to separate small training aircraft operations from the primary runway and increase capacity, the appropriate FAA runway length planning category is "95 percent of small aircraft with less than 10 passenger seats". As presented in **Table 3D**, the recommended runway length for this classification is 3,600 feet.

Table 3E
Business Jet Runway Length Requirements
Glendale Municipal Airport

Business Jet	Takeoff Length (feet)
Cessna Citation I[1,2]	4,800
Cessna Citation II	6,700
Cessna Citation III[2]	5,410
Cessna Citation V	4,300
Cessna Citation VI[2]	5,410
Beechcraft 400A	5,900
Dassault Falcon 10	5,700
Dassault Falcon 20	6,900
Dassault Falcon 50	5,800
Dassault Falcon 100	5,200
Gates Learjet 25[1,2]	5,500
Gates Learjet 30/35[1,2]	6,900
Gates Learjet 55[1,2]	7,300
Gates Learjet 60	6,000

[1] Runway length requirement determined at 100 degrees Fahrenheit
[2] Weight restrictions at design temperature

Runway Width

Runway width is primarily determined by the planning ARC for the particular runway. The planning ARC for Runway 1-19 is C-II. ARC C-II design standards specify a runway width of 100 feet. Currently, Runway 1-19 is 75 feet wide. Since business aircraft use of the airport is currently limited, the existing runway width is sufficient. Over the long range, it will be necessary to widen Runway 1-19 to 100 feet to safely serve increased business aircraft use of the airport and meet FAA design standards. A B-I I ARC has been designated for a potential parallel runway. FAA design standards specify a width of 75 feet for this ARC.

Pavement Strength

The most important feature of airfield pavement is its ability to withstand repeated use by aircraft of significant weight. The current strength rating on Runway 1-19 is 30,000 pounds single wheel loading (SWL) and 37,500 pounds dual wheel loading (DWL). A pavement strength of 60,000 pounds DWL is needed to adequately serve the projected fleet mix. A pavement strength of 12,500 pounds SWL is sufficient for a potential parallel runway.

TAXIWAYS

Taxiways are primarily constructed to facilitate aircraft movements to and from the runway system. Parallel taxiways enhance airfield capacity and are essential to aircraft movement about an airfield. Exit taxiways reduce the amount of time that an aircraft occupies the runway. Runway 1-19 is served by a full-length parallel taxiway located 240 feet west of the runway and seven entrance/exit taxiways. Taxiway widths vary from 25 to 40 feet.

Design standards for taxiway width and the separation distances between runways and parallel taxiways are based primarily on the Airplane Design Group (ADG). Design group II has been designated for Runway 1-19. Design standards specify a taxiway width of 35 feet and runway/parallel taxiway separation distance of 300 feet. The existing runway/parallel taxiway separation distance and Taxiway B and G widths (25 feet) do not meet minimum design standards. Taxiways D and F, which are 40 feet wide, exceed minimum taxiway width standards.

Design group II has been applied to the potential parallel runway design. Design standards specific a taxiway width of 35 feet and runway/taxiway separation distance of 240 feet.

The type and frequency of runway entrance/exit taxiways can affect the efficiency and capacity of the runway system. Right-angled exits require an aircraft to be nearly stopped before it can exit the runway. Acute-angled (high speed) exits allow aircraft to slow to a safe speed, without stopping, before exiting the runway. Both types of exits currently exist on the runway. The location and frequency of these exits is sufficient considering the existing runway length; any future extension of Runway 1-19; however, will need to consider the location of

these taxiways and if additional taxiways will be needed.

Holding aprons have been constructed at the Runway 1 and 19 thresholds. Holding aprons provide an area for aircraft to prepare for departure off the taxiway and allow aircraft to bypass which are ready for departure. These areas should be maintained through the planing period.

NAVIGATIONAL AIDS AND INSTRUMENT APPROACH PROCEDURES

Electronic navigational aids are used by aircraft during an approach to the airport. Such facilities are vital to the success of the airport and provide additional safety to passengers using the air transportation system and enhance the capacity and safety of the airfield. While instrument approach aids are especially helpful during poor weather, they are often used by pilots when visibility is good. Currently, there are no instrument approaches to the airport. Therefore, the airport is effectively closed during poor weather conditions when visual flight can no longer be conducted. The FAA is in the initial stages of developing Global Positioning System (GPS) approaches to the airport. The initial GPS approaches being developed provide only course guidance information. By the year 2000, it is expected that GPS approaches will also provide descent information. There will be no requirement for additional approach capability at the airport after this enhancement to GPS is completed.

The airport-owned non-directional beacon (NDB), located on the east side of the airport, provides directional guidance to pilots during visual conditions. The long range need for this facility will be dictated by the number of users and maintenance costs. The FAA is proceeding with a program to transition to GPS and phase-out existing ground-based navigational aids such as the NDB. The FAA program calls for all FAA-owned NDB's to be phased-out by the year 2005.

HELIPAD

A helipad is marked on the apron east of Glendale Aviation. This helipad is available for takeoffs and landings. A concrete helicopter pad has been constructed near the terminal building for use by air evacuation helicopters. This pad is restricted to hover/taxi operations and cannot be used for takeoffs or landings. Considering forecast helicopter use, these helipads are sufficient through the planning period and the previously planned heliport, to be constructed in the area north of Glendale Aviation, is not required.

LIGHTING AND MARKING

Currently, there are a number of lighting and pavement markings aids serving pilots using the Glendale Municipal Airport. These lighting and marking aids assist pilots in locating the airport during night or poor weather conditions, as well as assist in the ground movement of aircraft. The current and future lighting and marking requirements for the airport are summarized below.

Identification Lighting

The airport is equipped with a rotating beacon to assist pilots in locating the airport at night and a lighted wind cone which provides pilots with information about wind conditions. Each of the facilities is adequate and should be maintained in the future.

Airfield Lighting

Runway 1-19 is equipped with threshold lighting and medium intensity runway lighting (MIRL). Each taxiway at the airport is equipped with medium intensity taxiway lighting (MITL). These lighting systems identify the pavement edges and enhance the safety of operations at the airport. These systems should be maintained through the planning period. Since most training activity is conducted during daylight hours, it may be possible to construct a potential parallel runway without pavement edge lighting. Ultimately, airfield capacity would be maximized if this runway would not be limited to daylight use. While pavement edge lighting is not provided along the apron, the existing apron lighting is sufficient for aircraft operations at night and should be maintained.

Visual Approach Lighting

Visual glide slope indicators (VGSI) are a system of lights located at the side of the runway which provide visual descent guidance information to pilots during an approach to the runway. Runways 1 and 19 are equipped with a type of VGSI known as a precision approach path indicator (PAPI). The existing PAPI-2 system should ultimately be upgraded to a PAPI-4 to better serve business aircraft. The existing PAPI-2 systems could be transferred to the potential parallel runway should that runway developed. A PAPI-2 would enhance training operations to the runway.

Runway End Identification Lighting

Runway identification lighting provides the pilot with a rapid and positive identification of the runway end. The most basic system involves runway end identifier lights (REIL's). REIL's are normally installed to runways not equipped with a more sophisticated approach light system. The existing REIL's installed at the Runway 1 and 19 ends will enhance the safety the future GPS approaches.

Pavement Markings

Currently, Runway 1-19 is equipped with visual runway markings that identify the runway centerline, designation, aircraft holding positions, and pavement edge. Nonprecision runway markings are required for the future GPS approaches to Runway 1-19. Visual markings would be required for the potential parallel runway. The taxiway and taxilane centerline markings are sufficient and should be maintained through the planning period.

CONCLUSIONS

A summary of the airfield facility requirements is presented on **Exhibit**

3C. Should operations increase as forecast, additional runway capacity may be required to reduce aircraft delay. This may involve the development of a parallel runway. Additional runway length is required to adequately serve the full-range of business jets without reducing stage-length or loading capabilities. Additional runway width, pavement strength, and the upgrade of the existing PAPI-2 to a PAPI-4 would better serve business jets. Nonprecision runway markings will be required for the GPS approaches currently being established by the FAA.

LANDSIDE REQUIREMENTS

Landside facilities are those necessary for handling of aircraft and passengers while on the ground. These facilities provide the essential interface between the air and ground transportation modes. The capacities of the various components of each area were examined in relation to projected demand to identify future landside facility needs.

AIRCRAFT STORAGE HANGARS

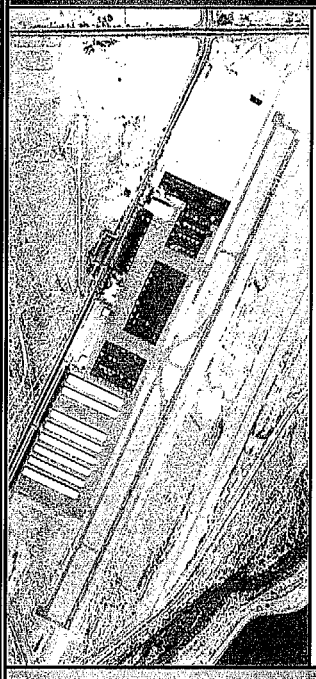
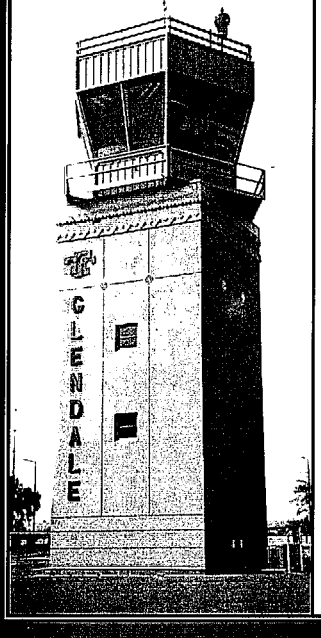
The space required for hangar facilities is dependent upon the number and type of aircraft expected to be based at the airport. Weather extremes at the airport can be severe at times and therefore will play a role in the decision to hangar an aircraft. Generally, however, most aircraft owners prefer to hangar their aircraft as opposed to tying them down outside. Currently, there are 108 enclosed T-hangar facilities, 111 shade hangar positions, and one 18,100 square-foot conventional hangar (utilized by the fixed base operator) at the airport.

T-hangars provide the aircraft owner more privacy and greater ease in obtaining access to aircraft than do conventional hangars. Shade hangars protect aircraft from weather, but do not provide the security of enclosed T-hangars. The principal uses of conventional hangars at general aviation airports are for large aircraft storage, storage during maintenance, and for housing fixed base activities. Currently, approximately 68 percent of based aircraft are stored in hangars. Future hangar requirements were determined based upon an assumption that this percentage would grow to approximately 78 percent of total based aircraft.

Table 3F estimates future hangar requirements for the airport. A planning standard of 1,200 square feet per based aircraft stored in T-hangars has been used to determine future T-hangar requirements. A planning standard of 2,500 square feet for large aircraft stored in conventional hangars has been used to determine future conventional hangar requirements. Conventional hangar area was increased by 10 percent to account for future aircraft maintenance needs.

AIRCRAFT PARKING APRON

A parking apron should be provided for at least the number of locally-based aircraft that are not stored in hangars, as well as transient aircraft. Currently, there are approximately 60 based aircraft occupying tiedowns at

	EXISTING	SHORT-TERM NEED (5 YEARS)	LONG-TERM NEED (20 YEARS)
RUNWAYS AND TAXIWAYS			
	**RUNWAY 1-19** • 5,350' X 75' • 30,000 lbs. SWL • 37,000 lbs. DWL • Full-length parallel taxiway (A) • Exit taxiways (B,C,D,E,F,G,H) • Helipad • Air Evac Pad	**RUNWAY 1-19** Same Same	**RUNWAY 1-19** • 7,500' X 100' • 75,000 lbs. DWL • Additional Exit Taxiways **PARALLEL RUNWAY** **(subject to further evaluation)** • 3,600' x 75' • 12,500 lbs. SWL Same
NAVIGATIONAL AIDS & LIGHTING			
	• Rotating Beacon • Precision Approach Path Indicator (PAPI-2) (Runways 1 and 19) REIL's (Runway 1-19) • Nondirectional Beacon (NDB) • Medium Intensity Runway and Taxiway Lighting (Runway 1-19) • Visual Runway Markings (Runway 1-19)	• Same • Same • Same • Global Positioning System Approaches • Same • Nonprecision Runway Markings (Runway 1-19)	• Same • PAPI-4 (Runway 1-19) PAPI-2 (Parallel Runway) • Phase-out NDB • Same • Same • Medium Intensity Runway Lighting (Parallel Runway) • Same • Visual Runway Markings (Parallel Runway)

GLENDALE MUNICIPAL AIRPORT

Exhibit 3C
AIRFIELD REQUIREMENTS

the airport. Although the majority of future based aircraft were assumed to be stored in an enclosed hangar, a number of based aircraft will still tiedown outside. Total apron area requirements were determined by applying a planning criterion of 700 square yards per transient aircraft parking position and 500 square yards for each locally-based aircraft parking position . The results of this analysis are presented in **Table 3G.**

TABLE 3F
Aircraft Storage Hangar Requirements
Glendale Municipal Airport

	Available	Current Requirements	Short Term	Intermediate Term	Long Term
Aircraft to be Hangared		128	170	225	292
T-Hangar and Shade Hangar Positions	219	115	150	195	252
Conventional Hangar Positions	8-15	13	20	30	40
Conventional Hangar Area (s.f.) [1]	18,100	17,100	30,700	52,500	74,300
T-Hangar and Shade Hangar Area (s.f.)	226,700	138,000	180,000	234,000	302,400
Total Hangar Area (s.f.)	236,700	155,100	210,700	286,500	376,700

[1] Includes area for aircraft maintenance

TABLE 3G
Apron Requirements
Glendale Municipal Airport

	Available	Current Requirements	Short Term	Intermediate Term	Long Term
Transient Aircraft Apron					
Positions	81[1]	28	37	53	76
Apron Area (s.y.)	--	19,600	25,900	37,100	53,200
Locally-Based Aircraft Apron					
Positions	157	60	65	75	83
Apron Area (s.y.)	--	30,000	32,500	37,500	41,500
Total Positions	238	86	102	128	159
Total Apron Area (s.y.)	132,600	49,600	58,400	74,600	94,700

[1] Includes 35 small aircraft and 7 large aircraft tiedowns controlled by Glendale Aviation

TERMINAL FACILITIES

Terminal building space is required for waiting passengers, pilot's lounge and flight planning, concessions, management, storage, and various other needs. This space is not necessarily limited to a single, separate terminal building but also includes the space offered by fixed base operators for these functions and services.

Terminal building space is available in both the public terminal building and at the Fixed Based Operation (Glendale Aviation) facility. The public terminal building provides areas for general public use and areas to provide general aviation services. This includes a flight planning area, public restrooms, lobby, concessions, office space, and a restaurant. Public space within the terminal building totals approximately 9,800 square feet. Concessions, flight planning, and office space is also available at the FBO facility and totals approximately 4,200 square feet.

Based on available terminal space and planning standards, the combined space of the terminal building and FBO terminal space is sufficient for existing and future passenger levels. Future terminal facility needs will be a function of individual FBO needs. Generally, an FBO which constructs a large aircraft storage and maintenance hangar will construct pilot and passenger facilities adjacent to the hangar.

VEHICLE PARKING AND ACCESS

Public vehicle parking is available at the FBO facilities, terminal building, and along the T-hangar and shade hangar area. Approximately 26 parking spaces are available at the FBO facility, 60 at the terminal building, 244 at the T-hangar and shade hangar area, and 100 in an overflow low located west of the terminal building.

Terminal building vehicle parking requirements have been determined utilizing a planning standard of 1.3 spaces per design hour passengers and 350 square feet for each parking position to account for drive lane and parking space requirements. Vehicle parking requirements for hangars and other aviation facilities at the airport were determined as a percentage of based aircraft utilizing the same multiplier described above. **Table 3H** outlines vehicle parking requirements for the airport.

Glen Harbor Boulevard provides access to all existing facilities along the west side of the airport. A traffic signal and right and left turn lanes are available at the Glen Harbor Boulevard/Glendale Avenue intersection. No additional improvements are needed for Glen Harbor Boulevard to safely and efficiently accommodate future vehicle traffic.

FUEL STORAGE

A total of 28,000 gallons of fuel storage is available in four underground storage tanks at the airport. Individually, there are two 10,000 gallon storage tanks and two 4,000 storage tanks. The underground fuel tanks are located in a fenced area south of the T-hangar and shade hangar area. These tanks were upgraded to meet Environmental Protection Agency (EPA) underground fuel storage regulations in 1997. Fuel storage requirements can vary based upon individual supplies and distributer policies. For this reason, fuel storage requirements will be dependent upon the independent distributors.

TABLE 3H
Vehicle Parking Requirements
Glendale Municipal Airport

	Currently Available	Current Requirement	Short Term	Intermediate Term	Long Term
Design Hour Passengers		34	40	56	81
Terminal Vehicle Spaces	186[1]	44	52	73	105
Parking Area (s.f.)	46,800	15,400	18,200	25,600	35,800
General Aviation Spaces	244	94	117	150	187
Parking Area (s.f.)	100,200	32,900	41,000	52,500	65,500
Total Parking Spaces	430	138	169	223	292
Total Parking Area (s.f.)	147,000	48,300	59,200	78,100	101,300

1 Includes overflow lot and FBO parking lot

MAINTENANCE HANGAR AND WASH BAY

A covered, two-bay aircraft wash facility is located near the air traffic control tower. A 5,000 square foot maintenance building is planned to be constructed adjacent to the west wall of the aircraft wash facility. These facilities are sufficient through the planning period.

OTHER LANDSIDE FACILITIES

An area for commercial general aviation hangar development is currently being planned for the vacant area south of the public terminal building and AirEvac pad. A taxiway is planned to be constructed off the apron and provide access to privately developed hangars for use in providing various general

aviation services such as avionics and aircraft upholstery repair as well as aircraft storage. After consideration has been given to providing for the long-range aviation needs of the airport, it is possible to designate available land area for aviation-related and nonaviation related commercial/ industrial development. The alternatives analysis will examine the potential development areas on the airport.

CONCLUSIONS

A summary of landside facility requirements is presented on **Exhibit 3D**. To accommodate forecast demand, additional enclosed T-hangar and conventional hangar space will be required through the planning period, even though there is available T-hangars and shade hangars at this time. The number of tiedowns and available apron area appears to be sufficient through the planning period; however, the number of designated based aircraft tiedowns should be reduced to provide additional transient tiedowns. The current number of vehicle parking spaces is in excess of current needs, however, these spaces may not be conveniently located near new development areas. Additional vehicle parking areas will be required adjacent to hangar development areas through the planning period.

96MP11-3D-2/24/97

	CURRENT NEED	SHORT-TERM NEED	INTERMEDIATE NEED	LONG-TERM NEED
AIRCRAFT STORAGE HANGARS				
	Existing			
Shade and T-hangar Positions	219	115	150	195	252
Conventional Hangar Positions	8-15	13	20	30	40
Shade and T-Hangar Area (s.f.)	226,700	138,000	180,000	234,000	302,400
Conventional Hangar Area (s.f.)	18,100	17,100	30,700	52,500	74,300
Total Hangar Area (s.f.)	236,700	155,100	210,700	286,500	376,700
APRON AREA				
	Existing			
Transient Apron Positions*	81	28	37	53	76
Locally-Based Aircraft Positions	157	60	65	75	83
Total Positions	238	88	102	128	159
Total Apron Area (s.y.)	132,600	49,600	58,400	74,600	94,700

* Includes 35 small aircraft and 7 large aircraft tiedowns controlled by Glendale Aviation

VEHICLE PARKING				
	Existing			
Terminal Vehicle Spaces	186	44	52	73	105
General Aviation Spaces	244	94	117	150	187
Total Parking Spaces	430	138	169	223	292
Total Parking Area (s.f.)	147,000	48,300	59,200	78,100	101,300

* Includes Glendale Aviation Parking Lot and Overflow Lot

GLENDALE MUNICIPAL AIRPORT

Exhibit 3D
LANDSIDE REQUIREMENTS